P2 Optical Probe for Measuring the Extent of Air/Fuel Mixing in Premixed Combustion Turbines

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Abstract

Introduction

Control of combustion driven oscillations in lean premixed combustors continues to be a challenge for the combustion engineer. In general, the combustion driven oscillations have been avoided through trail and error because a guiding model is lacking. In the past, it has been difficult to determine the cause of the combustor oscillations, but it has been possible to measure the result (pressure oscillations).

Objective

We measure one of the physical processes thought to cause combustor driven oscillations. The extent of air/fuel mixing has been postulated as an important factor leading to combustion oscillations. We measure the extent of air/fuel mixing in reacting and non-reacting conditions and relate it to the magnitude of pressure oscillations in the combustion chamber.

Project description

Measurement of the relationship between fluctuations in air-fuel ration (AFR) and combustion oscillations in a lean premixed dump combustor are reported. The one-dimensional air-fuel ratio fluctuations are determined by measuring the absorption of laser light from a 3.39 μm Helium-Neon laser. The laser light is passed through the air/fuel premixing section. The extent of mixing is varied by moving the fuel injection location.

Results

We find that the fluctuations in air-fuel ratio and fluctuations in pressure are very dependent on the length of the dump combustor, the premixing distance, and the extent of air-fuel mixing (without combustion).

Future Work

Currently, we are designing an optical probe for high pressure and temperature environments. The optical probe will be tested in a combustion rig at General Electric Corporate Research and Development Center. We will be measuring the effect of combustion driven oscillations on the extent of air/fuel mixing.

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